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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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Introduction

This document specifies requirements and recommendations applicable to ice management for oil and gas operations in arctic and cold regions.

Ice management (IM) is defined as the sum of all activities, carried out with the objective to mitigate hazardous situations by reducing or avoiding actions from any kind of ice (sea ice or glacial ice), and includes:

— establishment of an understanding of the ice regime and potential ice hazards prior to the initiation of operations;

— operational surveillance, including detection, tracking and forecasting;

— identification and evaluation of any physical threat to the operation;

— a working ice alert system and associated procedures;

— physical ice management by the supporting IM vessels, including ice breaking and/or iceberg management;

— procedures associated with the safe avoidance of potentially hazardous ice;

— documentation of IM performance and revision of the IM system to ensure continuous improvement;

— relevant procedures associated with the safe shut-down of floating structures (moored or DP), both active (move off and ice management) or semi passive (ice management, but no move off);

— relevant procedures associated with the safe shut-down of bottom-founded structures, both active (with ice management and move-off capability), or passive (fixed with ice management).

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This document describes performance requirements and recommendations to ensure timely identification of ice hazards, their mitigation through ice management, and securement of the facility if necessary.

This document is intended to ensure that ice management operations are planned, engineered, integrated and implemented whenever needed. Performance requirements of an ice management system can depend on the type of facility and the operations undertaken on the facility. Particular emphasis is placed on ensuring adequate performance in circumstances where there is little prior experience with a particular facility or in a particular geographical region.

This document consists of a normative part and an informative part. The normative part considers the overall operations, hazards and possible counter measures, systems and procedures.

Annex A contains a HAZID workbook, which is to be used in conjunction with the relevant clauses when preparing an ice management plan.

Annex B provides informative data, which supplements the normative part and is to be read in conjunction with the main body of the document.

There are other International Standards which are also relevant to ice management, such as ISO 35101 for working environments and ISO 35106 for arctic and cold regions data requirements (for design and operation). In addition, ISO 19900 specifies general principles for the design and assessment of offshore structures subjected to known or foreseeable types of actions, applicable worldwide to all types of offshore structures, including bottom-founded structures as well as floating structures, and ISO 19906 specifies requirements and provides recommendations and guidance for the design, construction, transportation, installation and removal of offshore structures, related to the activities of the petroleum and natural gas industries in arctic and cold regions.

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Petroleum and natural gas industries — Arctic operations — Ice management

1 Scope

This document establishes the principles, specifies the requirements and provides guidance for ice management (IM) in arctic and cold regions, from the point of view of planning, engineering, implementation and documentation. Reference to arctic and cold regions in this document is deemed to include both the Arctic and other regions characterized by low ambient temperatures, sea ice, icebergs and icing conditions. These regions are often remote and lacking in marine and communications infrastructure.

Ice management to support the following in-ice activities and infrastructures are covered by this document:

— floating moored and/or dynamically positioned drilling vessels, coring vessels, production facilities and work-over vessels;

— construction and installation (includes trenching, dredging, pipe laying);

— tanker loading and other offloading operations;

— protecting subsea structures and equipment;

— seismic operations;

— oil spill response;

— bottom founded structures (fixed platforms and movable structures, including jack-ups).

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This document also applies to mobilization, demobilization and construction support services, because these can be affected by ice conditions.

In view of the wide range of possible offshore operations in arctic and cold regions, this document provides guidelines, but does not present typical ice management plans for field operations.

This document does not provide requirements, recommendations or guidance pertaining to the design of structures, systems and components used in ice management, beyond the principles given. This document does not provide specific formulations for ice loads, which are covered by ISO 19906.

This document is not applicable to coastal port operations and to commercial trading vessels conducting transit or convoy operations.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 19901-1, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 1: Metocean design and operating considerations*

ISO 19901-6, *Petroleum and natural gas industries — Specific requirements for offshore structures — Part 6: Marine operations*

ISO 35106, *Petroleum and natural gas industries — Arctic operations — Metocean, ice, and seabed data*

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POLAR CODE IMO International Code for Ships Operating in Polar Waters

IMO STCW. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers

WMO n° 574, Sea ice information services in the world

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1.1
design
process of designing facilities and the IM system to be used for the intended operations

3.1.2
design ice envelope
range of offsets and combined ice and metocean actions that pose no threat to the facility or operation

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Note 1 to entry: See 3.1.22 for factored design ice envelope or operating ice envelope.

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3.1.3
facility
plant, rig, or platform, fixed or floating, stationary or mobile, on- or offshore, for use in oil and gas exploration, production or support.

Note 1 to entry: In this document, the term 'facility' is often used to represent the full range of facilities and operations supported by IM, as outlined in Clause 1.

Note 2 to entry: Under certain circumstances, the term 'facility' can also be deemed to include tankers and other vessels connected to the rig or platform.

Note 3 to entry: The term 'facility' is also used to define training centres.

3.1.4
hazard
potential source of harm

Note 1 to entry: Harm is typically differentiated between harm to personnel, harm to the environment, or harm in terms of costs to organization(s) or society in general.

3.1.5
hazard identification
systematic identification of all plausible hazards for IM operations, including detection, monitoring, ice alerting, dissemination and human factors

3.1.6
HAZID table
formalized tabular method of addressing hazard identification for different operations

3.1.7
ice alert
mandatory system response to an ice hazard

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3.1.8
ice alert colour code
system consisting of colours, each defining a specific status of the operation, in which the colour defines the risk level

3.1.9
ice alert system
ice alerting system
staged series of mandatory system responses to ice hazards

3.1.10
ice certificate
design curves or envelopes of best estimates for admissible (safe) speeds for the vessel in various ice conditions, with or without IM vessel or escort vessel

Note 1 to entry: The ice certificate was originally developed as a Russian safe speed system and is presently adopted by several classification societies. The IMO Polar Code requires a polar ship certificate (using POLARIS or similar system) that includes similar information to the ice certificate. In addition, the IMO Polar Code requires a polar waters operations manual.

Note 2 to entry: The ice certificate is not generic, but is ship and operation specific.

3.1.11
ice detection
procedures used to identify specific ice features and conditions within prevailing metocean conditions

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3.1.12
ice hazard
hazardous ice
ice event triggering an ice alert

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Note 1 to entry: Ice events can involve ice conditions or ice features and their proximity to the facility, in combination with particular metocean conditions.

Note 2 to entry: Potentially hazardous ice or a potential ice hazard can involve ice features or conditions with the potential to activate an ice alert at some time in the future.

3.1.13
ice hazard distance
distance of potentially hazardous ice from the facility

3.1.14
ice hazard time
estimated time for potentially hazardous ice to reach the facility

3.1.15
ice management plan
IM plan
plan associated with offshore ice management operations for a specific facility at a specific site

3.1.16
ice management system
IM system
all elements used for ice management combined in a systematic manner

Note 1 to entry: This includes detection, monitoring and forecasting, decision making, hazard analysis, physical ice management, ice alerting, recording, performance analysis and continuous improvement.

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3.1.17
ice regime
consistent and recurring ice conditions

Note 1 to entry: The ice management (IM) and ice alert systems are applied to transform the ambient ice regime into a managed ice regime reaching the protected facility or operation.

3.1.18
multi-year ice
sea ice that has survived at least two summers' melt seasons

3.1.19
nowcast
present state of ice and metocean conditions based on the best available data and interpretations, and representing the starting point for future forecasts

3.1.20
offshore installation manager
competent person, certified according to applicable regulations, appointed to manage the offshore activities of the facility

3.1.21
old ice
sea ice that has survived at least one summer's melt season

3.1.22
operating ice envelope
factored design ice envelope, representing the most severe combination of ice and metocean actions or conditions under which the facility is allowed to operate

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Note 1 to entry: Factors can be specified or dictated by design standards to ensure adequate structural or operational reliability.

Note 2 to entry: A relationship can be established between the ice and metocean actions (loads) on the facility and the ice and metocean conditions associated with the managed ice regime.

3.1.23
polar low
small-scale, short-lived, atmospheric low pressure system (depression) within the context of larger mesoscale weather systems

3.1.24
recording
all processes used to record collected data

Note 1 to entry: Forms of recording can be in log books, spread sheets or as part of an electronic data collection system.

3.1.25
T-time
termination time
time required to ensure the safety of the facility

Note 1 to entry: The T-time can potentially involve securing wells, as well as disconnection and move-off for a floating structure.

Note 2 to entry: The T-time can vary according to the particular operation being carried out on the facility, whether the facility is in a normal or emergency operating state, and on the progress of procedures undertaken to ensure the safety of the facility.

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3.1.26
T-distance
termination distance
distance equal to the drift speed of an ice hazard toward the facility multiplied by the T-time

3.1.27
threat assessment
analysis of occurrence, timing, extent and probability that the operating ice envelope of a facility is likely to be exceeded

3.1.28
unanticipated event
combined ice and metocean event that has not been incorporated in the IM and ice alert systems, but which could occur and affect the facility or operation

3.1.29
unforecast event
combined ice and metocean event that has not been forecast, but which could occur and affect the facility or operation

3.2 Abbreviated terms

AARI Arctic and Antarctic Research Institute (St. Petersburg, Russia)

CIS Canadian Ice Service (Ottawa, Canada)

CPA closest point of approach

DP dynamic positioning

DS ice drift speed

EER escape, evacuation and rescue

HAZID hazard identification

HSSE health, safety, security and environment

HT ice hazard time

IM ice management

IMO International Maritime Organization

MMO marine mammal observer

MT move off time

NIC National Ice Center (Washington DC, USA)

OIM offshore installation manager

ST secure time

UAV unmanned aerial vehicle

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4 General ice management requirements

4.1 Fundamental requirements for an ice management system

4.1.1 General

An IM system shall be implemented

a) if required according to the design criteria for a facility, e.g. ISO 19906, or

b) to support a facility or operation listed in Clause 1, where an assessment has been made and it has been determined that an IM system is required.

For a facility or operation covered by point b), the assessment should consider design and operational constraints, the local ice regime for the season(s) under consideration, and the capacity to withstand ice actions.

To ensure that the IM system functions as intended, acceptance criteria shall be established using the measures of IM performance outlined in Clause 6.

4.1.2 Ice management plan

All IM assets, systems and procedures shall be documented in an IM plan (see Clause 5).

The IM plan shall remain in place over the design service life of the facility or the duration of the operation protected by the IM system and shall be revised to reflect changes to the operation of the facility, to the physical environment, and to IM assets, systems and procedures.

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The IM plan shall apply to a specific facility or operation and should only be reused if the operation is repeated with the same IM assets under the same circumstances.

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4.1.3 Ice alert system

An IM plan shall include an ice alert system, which involves specified operational responses to hazardous ice conditions, the status of the facility and parameters associated with the facility. Specified operational responses can include:

1) physical ice management to prevent potentially hazardous ice conditions from becoming hazardous, whether by changing the drift trajectory of ice features, reducing the size of ice features or applying other strategies;

2) other procedures and activities associated with the IM system;

3) suspension of operations;

4) securement or shut-in;

5) evacuation of personnel;

6) disconnection and move-off;

7) abandonment of facilities that cannot be moved.

The status of the facility can involve:

a) the types of operations being conducted on the facility and their progress;

b) the status of the stationkeeping system, where applicable;

c) whether the facility is in a normal or emergency operating state.

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Parameters associated with the facility can include:

— offsets or other displacements;

— measured loads;

— vibration levels.

The ice alert system shall involve stages or levels, each of which is defined in terms of a time to enact operational responses to specified ice hazards.

For circumstances when any part of the ice alert system cannot be executed, contingency measures shall be in place, including an emergency response plan and the assets available for its enactment.

When a facility is reliant on IM operations (see 4.1.1), compliance with the ice alert and emergency response systems is mandatory.

Further ice alert system requirements are provided in 6.5 and 9.5.

4.1.4 Hazardous ice conditions

Hazardous ice conditions are those triggering responses within the context of the ice alert system. Such conditions can involve:

a) proximity of an ice feature to the facility or operation under the protection of the IM system;

b) size or thickness of the ice feature or features;

c) manageability of the ice features or conditions;

d) drift speed or wave-induced motions of the ice feature;

e) encroachment of ice into or onto a part of the facility that is not designed to resist ice actions;

f) pack ice pressure.

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4.2 Safety requirements

4.2.1 Ice management approach

The commitment of IM resources and the deployment strategy should be consistent with the type of operation undertaken and with ice and metocean conditions.

4.2.2 Redundancy

Redundancy should be considered for all aspects of IM operations, including systems, procedures, and resources. The degree of redundancy should include allowance for downtime due to maintenance.

Redundancy should also be provided for data collection, storage, communication, and presentation systems to ensure that data streams are maintained regardless of weather, temperature, precipitation, and in the event of power failures. Redundancy should include flexibility in terms of the location of the IM base of operations.

Redundant systems and barriers should be verified to ensure adequacy with respect to common causes and independent functionality.

4.2.3 Existing operations

IM operations should be planned and executed with a full knowledge of the operating procedures associated with adjacent facilities and other activities in the region. Details of existing practices,

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